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AN INTEGRATED DECISION SUPPORT
SYSTEM FOR TRAC: A PROPOSAL

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INTRODUCTION

- Optimal allocation and usage of resources is a key to effective management.
- Resources of concern to TRAC are: Manpower (PSY), Money (Travel, contracts), Computing, Data, Models, etc.
- Management activities of TRAC include: Planning, Programming, Tasking, Monitoring, Updating, and Coordinating.
- Existing systems are insufficient; not completely automated; manpower intensive; potential for data inconsistency exists.
- Proposed system provides a means to integrate all project management activities of TRAC through the development of a sophisticated software and by utilizing the existing computing systems and network resources.

EXISTING SYSTEM ARCHITECTURE

- Independent systems for Study Program, Work Program, Manpower Utilization Reporting, Taskers, and Tracking Data Requests.
- Study Program:
 1. The system is developed using DBASE-3 on IBM-PC.
 2. This database only resides at RPD and is also accessed by RPD only.
 3. The system does not store the history of a study over its life time. It can only store information on three consecutive fiscal years (past, current, and next) at any given point.
 4. RPD mails the software on a floppy to TRADOC agencies. Users enter study request information using this software and send this information electronically or by US mail to RPD.
 5. RPD merges the requests and arrives at a consolidated list.

6. No history of changes to the study program is maintained. The original information is itself changed to reflect any new changes.
7. Status of the Studies in the program are printed once in a quarter and disseminated.

- Work Program:

1. No automatic linkage between the study program and work program exists at present.
2. Changes in the study program are not automatically reflected in the work program. Manual intervention is necessary to make these changes.

- Manpower Utilization Reporting:

1. An independent system, MURS, maintains manpower utilization information.
2. MURS is developed on DBASE-3 to run on a PC. It is being ported to run on Foxbase on Intel.
3. Each agency enters its manpower usage information and mails the floppy to TRAC RPD. RPD consolidates the information.
4. There is no automatic linkage between MURS and Work Program.

- Taskers:

1. DBASE-3 based system is used to track status of taskers. There is no automatic link between the study program database and this system.
2. Only RPD maintains it and uses it.

PROPOSED SYSTEM ARCHITECTURE

- A distributed database system - the TRAC agencies are the processing sites connected through a network.
- TRAC RPD at Fort Monroe is the principal site and contains additional software to maintain global consistency of data.
- The communication system consists of the Ethernets at the local sites, the IBM/SNA network, MILNET, and the networking through the Tracer.
- Each TRAC site contains a copy of the entire database.
- Non-TRAC sites will continue to interact with RPD by exchanging information non-interactively (e.g. Mail floppies).
- A site may contain either ORACLE software or DBASE-3 software.
- Each site functions autonomously for both data access and updates. In addition, a user at a site needs to access only the local copy of the database.

- The failure or unavailability of a site or communication channel will not affect the functionality of other available sites.
- The access rights to the data elements are clearly defined on a need-to-know basis. This will be implemented using the security features of the database software (ORACLE or DBASE-3) augmented with additional software developed by us.
- The distribution of data will be transparent to the TRAC users. That is, users need not be concerned about the data distribution.

PROPOSED SYSTEM FEATURES

1. The database is an integrated TRAC decision support system.
2. Updates made at a local site are automatically propagated to all relevant sites. To minimize network usage, updates will be propagated once or twice in a day.
3. In case a local site is down, it may be possible for users at that site to access database at other sites (or at least at the principal site).
4. Fast (local) access to data at any of the TRAC agencies.
5. A user friendly interface.
6. Multi-level security to the information in the database.
7. Fast and easy dissemination of information. E.g. Changes in Study Program.

8. Insure consistency within TRAC data.
9. Minimize duplication of efforts.
10. Ability to compare the actual versus planned utilization of resources.
11. On-line access to results (intermediate/final) from a study.

SUMMARY OF PLAN

- PHASE I: Since Study Program is the basis for a majority of TRAC activities, this will be taken up in this phase. In addition, this phase will solve the major problems related to distribution of data and communication between the sites. It will extend the existing Study Program information by adding Tasker scheduling information.
- PHASE II: This will extend the database to include Work Program and Manpower Utilization information.
- PHASE III: This extends the system to include data request tracking, model requests, monitoring of schedules, etc.

PHASE I - DEVELOPMENT

STUDY PROGRAM

- Guidance for AR 5-5 Study programs for next fiscal year.
- Requests for new or continuing studies for next fiscal year.
- Assign priorities.
- Authorize studies.
- Allocate resources.
- Tasker scheduling information.
- Update the program: termination, deletion, addition, updation, or completion.
- Past history to guide future programs.
- Handle arbitrary queries on the past, current, and next study programs.

PHASE I BENEFITS

- The latest guidelines are available on-line at the users' site.
- Possible to implement a complex priority scheme. This procedure can also be made available to the agencies.
- Since the study requests made so far are available at the RPD and other sites, it is possible to eliminate duplications at an early stage.
- By automatic linking of study authorization with resource allocation, speed and consistency can be achieved.
- Since agencies can update the status of a study locally, this information is more likely to be up-to-date.
- Since the status of a study is available to all agencies, other agencies can easily use this information for their planning.
- If reports, results etc. coming out of a study are made available at the agency's site, they can be easily retrieved by other agencies.
- Ability to access the data on previous programs increases the efficiency of future programs.
- Ability to handle arbitrary queries improves turn-around time of responses.
- It is possible not only to update a program, but also include comments indicating the reasons for the changes.

MAJOR TASKS IN PHASE I

1. **System Requirements:** An in-depth study of the Study Program and Taskers. It is also necessary to study how the decisions in this phase will influence development of other phases.
2. **ORACLE Database:** Study and experiment with the ORACLE software to determine its features, cost of these features, and its limitations.
3. **DBASE-3 Database:** Study and experiment with the DBASE-3 software to determine its features, cost of these features, and its limitations.
4. **Security:** Study and test the security features offered by ORACLE and DBASE-3. Check if these satisfy the TRAC's requirements. If not, determine ways to provide the additional security.

5. **Communications:** Study and experiment with the available communication facilities at TRAC. If the existing communication software cannot be directly used by the distributed database system, then some additional communication software may need to be developed to achieve the desired functionality: security, efficiency, and ease of use.
6. **Heterogeneity:** Since we are dealing with two different database software systems, we need to deal with the problems of heterogeneity. This requires the study of interoperability issues.
7. **Update Protocols:** Since the updates are made locally (at the sites) and sent to the primary site (RPD) at designated times, we need to develop a special monitor process that can accumulate the updates within a period and forward it to the primary site. Similarly, we need to develop a process at the primary site that can reliably propagate updates to all the TRAC sites. **Reliability** is the key. Issues such as the unavailability of a site, unavailability of a communication channel, and faulty communication channels need to be considered here.

8. **Consistency Checks:** In addition to the update protocols, it may be necessary to run some global consistency check protocols, probably run once in a week, to check the consistency of the global database.
9. **Communication Security:** Depending on TRAC's requirements, if the security offered by the existing communication systems for data transmission is insufficient, additional methods such as encoding or data compression may need to be developed and tested.
10. **Database Design:** Having studied the users' requirements, a database system needs to be designed. This requires the definition of the fields and their type, design of the relations, deciding the type of indexing, selection of additional secondary index tables, etc. To keep the data meaningful, we also need to arrive at some integrity constraints defined on the relations.
11. **Query and Form Design:** Write code (for ORACLE and DBASE-3) to execute the desired queries and print reports. This should be done at least for the existing reports and some known types of queries. However, a user may have to develop code for any special queries not covered in this phase.

12. **User Interface:** Depending on the facilities offered by ORACLE and DBASE-3 and depending on the sophistication of the TRAC's requirements, additional efforts may have to be expended to design a user interface to the decision support system.
13. **Implementation:** The system needs to be implemented on ORACLE and DBASE-3. It also needs to be rigorously tested.
14. **Actual Data:** Once the testing phase is completed, the system is ready to be used. The actual data may now be placed into the system.
15. **User Training:** All TRAC users (or their representatives) need to be trained on system usage.
16. **Complaints/Comments:** We should also provide an automatic system to register any problems or improvements needed by the database system users. These should be looked into by the RPD personnel.

SCHEDULE FOR PHASE I

Activity	Time (in Weeks)	Period
System Requirements: Development	4	May'90
ORACLE Software: Study & experiment	3	May'90
DBASE-3 Software: Study & experiment	2	May'90
Database Security: Study & Develop	6	June-July'90
Communications: Study & Develop	5	June-July'90
Update Protocols	4	June-July'90
Communication Security	4	Aug'90
Database design	4	Aug'90
Consistency and Integrity	4	Sept'90
Query and Form Design	4	Sep'90
User Interface	6	Sep-Oct'90
Implement and Test	4	Oct'90
Incorporation of Actual data	2	Nov'90
Complaint/Comment Software	3	Nov-Dec'90
Documentation and User Training	4	Dec'90

FEASIBILITY

- ORACLE and DBASE-3 are two well established and proven database software systems. Since the proposed system is based on these, the chances of success are very high.
- A communication network system already exists between all TRAC sites. Even though it is only being used for Email, it should not be difficult to develop the required communication software on top of the existing system. The expertise of Mr. Hugh Dempsey, CIO, will be sought in developing this software.
- The staff at RPD are well versed with the existing systems. They are also clear on the inclusions to be made in the proposed system. This would make the system requirement development an easy task.

- The principal investigator, Ravi Mukkamala, is well versed with the issues and problems that arise in a distributed database system. Thus, protocol development for propagation of updates, data consistency, and handling site/link failures should not be difficult. Issues that require complete knowledge of ORACLE and DBASE-3 can be solved once these two systems are studied and experimented with.
- Implementing data security and communication security may be the most difficult tasks. Once again, we need to study the two database softwares and the communication systems to arrive at concrete code.
- Query and form design is not difficult. Both the ODU students that are committed (if paid) to this project are familiar with SQL. They have extensive experience in programming on DBASE-3. In addition, RPD staff currently handling the databases, are also very well versed with DBASE-3 programming.

EXTENSIBILITY AND MAINTAINABILITY

- Since the proposed system is based on a commercial database product, it should be easy to modify the database. The current RPD staff will be able to make changes related to: adding fields, creating additional relations, adding more queries, modifying the existing queries, etc.
- The problems in communications systems are more severe. They require the expertise of RPD staff such as Mr. Hugh Dempsey. If the communication system between the TRAC agencies is changed, then the communication software of this system also needs to be changed.
- Modifying the user-interface, once developed, may be more involved. The degree of difficulty will depend on its structure and the familiarity of the RPD staff with this software. Training one or two staff members at RPD may solve this problem.
- Extending the system from Phase-I to other phases should not be difficult due to the extensibility of relational database structures.

COST AND BENEFITS

- The ODU team will consist of the principal investigator and two graduate students. Each of the graduate students should be paid about \$8,000 for the duration of the project. The principal investigator should be paid \$15,000 as a summer salary and some release time during the Fall semester. Total: \$31,000
- The ODU Research Foundation charges an overhead of 45%. In this case it would be \$13,950. The overall cost up to Phase I is approximately \$45,000.
- As a result of implementing the proposed system, TRAC can reduce duplication of efforts in maintaining different databases, achieve data consistency, and establish a strong base for an effective decision support system.

PHASE II - EXPANSION

INTEGRATION OF STUDY PROGRAM WITH WORK
PROGRAM AND MURS.

PHASE III - FURTHER INTEGRATION

INTEGRATION OF DATA TRACKING, MODELS,
AND SCENARIOS.

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